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# 11. Performance Approach

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## 11.1 Overview

This chapter summarizes the whole building performance approach to compliance. It includes a discussion of computer methods, the procedures involved in determining the energy budget and the proposed building's energy use, and how to plan check performance compliance. The basic procedure is to show that the Time Dependent Valuation (TDV) energy of the proposed design is less than or equal to the TDV energy of the standard design, where the standard design is a building with the same geometry as the proposed design, but the features are defined by the prescriptive package requirements.

The performance method is the most detailed and flexible compliance path. The energy performance of a proposed building design can be calculated according to actual building geometry and site placement. Credit for certain energy features, such as a high efficiency mechanical system, cannot be taken in the prescriptive approach, but can be evaluated with an approved compliance software program.

The contents of this chapter are organized as follows:

- Section 11.2 describes the performance method changes made for the 2013 code cycle.
- Section 11.3 describes the basic concepts and procedures used to demonstrate compliance, including the rules used to generate the annual energy budget.
- Section 11.4 reviews the basic scenarios for compliance, including cases when the permit application includes less than a whole building such as an alteration or an addition.
- Section 11.5 outlines the enforcement and compliance process, including the plan check documents required when using the performance approach.

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## 11.2 Performance Method Changes Made In 2013

For the 2013 standards the Nonresidential Alternative Calculation Method (ACM) manual has been divided into two parts. The Nonresidential ACM Approval Manual describes the application and approval process for submitted compliance software. This document is adopted as part of the standards rule making process. The Nonresidential ACM Reference Manual is approved by the Commission. This document includes explanations of the rules that all compliance software programs use to model the energy performance of the Proposed Design Building and the Standard Design Building. The reference manual also includes an explanation of the reference method and certification tests used by the Energy Commission to approve compliance software tools. The Nonresidential ACM Reference Manual is approved by the Energy Commission and, like the residential and

nonresidential compliance manuals can be updated to allow for corrections and enhancements during the 2013 standards cycle.

### **11.2.1 Performance Concepts**

The Warren-Alquist Act requires “performance standards,” which establish an energy budget for the building in terms of energy consumption per ft<sup>2</sup> of floor space. This requires a complex calculation of the estimated energy consumption of the building, and the calculation is only suited for a computer. The Energy Commission has developed a public domain computer program to do these calculations. For compliance purposes, it also approves the use of privately developed computer programs as alternatives to the public domain computer program. The public domain computer program and the Commission-approved privately developed programs are officially called alternative calculation methods (ACMs). It's easiest to talk about these programs as "compliance software," and we will use that term throughout this manual.

### **11.2.2 Minimum Capabilities**

Approved programs must simulate or model the thermal behavior of buildings including envelope surfaces, lighting, space conditioning and service water heating systems. The calculations take into account:

- Conductive and convective heat gain and heat loss through walls, roof/ceilings, doors, floors, windows, and skylights.
- Solar radiant heat gain from windows, skylights, and opaque surfaces.
- Heat storage effects of different types of thermal mass.
- Building operating schedules for people, lighting, equipment and ventilation.
- Space conditioning system operation including equipment part load performance.

### **11.2.3 California Energy Commission Approval**

#### **11.2.3.1 Alternative calculation methods**

Alternative calculation methods must be approved by the California Energy Commission. Approval involves the demonstration of minimum modeling capabilities required input and output, and adequate user documentation. The program must be able to:

Automatically calculate the custom energy budget of the standard design.

Calculate the energy use of the proposed design in accordance with specific fixed and restricted inputs.

Print the appropriate standardized compliance forms with the required information and format if a proposed building complies. Other reports that do not resemble forms may be printed for non-complying buildings.

### **11.2.3.2 Input and output requirements**

Input and output requirements and modeling capabilities are tested by using the program to calculate the energy use of certain prototype buildings under specific conditions, and the results are compared with the results from a reference computer program, which is Energy Plus. These requirements for compliance software are explained in detail in the Nonresidential ACM Reference Manual.

## **11.2.4 Time Dependent Valuation (TDV)**

Beginning with the 2005 Standards, the metric or “currency” for assessing building performance is time dependent valued (TDV) energy. TDV energy replaced source energy, which had been the compliance metric since the California Energy Commission first adopted Standards in 1978.

As the name implies, TDV values energy differently depending on the day of the year and hour of the day that a specific type of energy is used. This means that electricity saved on a hot summer afternoon will be worth more in the compliance process than the same amount of electricity saved on a winter morning. The value assigned to energy savings through TDV more closely reflects the market for electricity, gas, propane and other energy sources and provides incentives for measures, such as thermal storage or advanced day- lighting, that are more effective during peak periods.

Reference Joint Appendix JA3 provides more information on TDV energy, and detailed TDV data is available from the California Energy Commission upon request. §100.2 states: “TDV multipliers for propane shall be used for all energy obtained from depletable sources other than electricity and natural gas.”

### **11.2.4.1 Professional Judgment**

Certain modeling techniques and compliance assumptions applied to the proposed design are fixed or restricted. That is, there is little or no freedom to choose input values for energy compliance modeling purposes. However, there are other aspects of energy modeling where some professional judgment may be acceptable or even necessary. In those instances, the compliance software user must exercise proper judgment in evaluating whether a given input is appropriate.

Enforcement agencies have discretion to question a particular input if the permit applicant cannot substantiate the value with supporting documentation or cannot demonstrate that appropriate professional judgment has been applied.

### **11.2.4.2 Two questions may be asked**

Two questions may be asked in order to resolve whether good judgment has been applied correctly in any particular case:

1. Is a simplified input or assumption appropriate for a specific case? If simplification reduces the predicted energy use of the proposed building or reduces the compliance margin when compared to a more explicit and detailed modeling assumption, the simplification is not acceptable. That is, simplification must reflect the same or higher energy use than a more detailed model, and reflect the same or lower compliance margin when comparing the standard and proposed TDV energy.

2. Is the approach or assumption used in modeling the proposed design consistent with the approach or assumption used by the compliance software when generating the standard design energy budget? One must always model the proposed design using the same assumption and/or technique used by the compliance software when calculating the energy budget unless drawings and specifications indicate specific differences that warrant energy compliance credits or penalties.

Any unusual modeling approach, assumption or input value should be documented with published data and, when applicable, should conform to standard engineering practice.

*Figure 11-1 – Annual TDV Energy Use Summary (Sample of PERF-1)  
[Note: Figure may vary due to different compliance software versions].*

#### Example 11-1

##### Question

Three different sized windows in the same wall of a new one-story office building are designed without exterior shading, and they have the exact same NFRC-rated U-factors and SHGC values. Is it acceptable professional judgment to simplify the computer model by adding the areas of the three windows together and inputting them as a single fenestration area?

##### Answer

Yes. The compliance software will produce the same energy results whether or not the windows are modeled individually or together as one area because the orientation, fenestration U-factors and SHGC values of the windows are identical. However, if overhangs and side-fins are modeled, the correct geometry of fixed shades must be modeled for each window.

## 11.3 Analysis Procedure

### §140.1

This section is a summary of the analysis procedures used in demonstrating compliance with *approved compliance software programs*. Program users and those checking for enforcement should consult the most current version of the compliance software user's manual and/or on-line Help and associated compliance supplements for specific instructions on the operation of the program. Although there are numerous requirements for each compliance software input, the data entered into each software version may be organized differently from one program to the next. As a result, it is not possible in this summary to present all variables in their correct order or hierarchy for any one program. The aim is simply to identify the procedures used to calculate the standard design energy budget and the TDV energy use of the proposed building.

### 11.3.1 General Procedure

Any approved compliance software version may be used to comply with the Standards. The following steps are a general outline of the process:

- All detailed data for the building component or components must be collected including fenestration areas and energy properties, wall, door, roof/ceiling, and floor areas, construction assemblies, solar heat gain coefficients, mass characteristics, equipment specifications, lighting, and service water heating information from the drawings and specifications.
- Although most computer programs require the same basic data, some information, and the manner in which it is organized, may vary according to the particular program used. Refer to the compliance supplement that comes with each program for additional details.
- Be sure that the correct climate information has been selected for the building site location (see Reference Joint Appendix JA2). Compliance software also adjusts outside heating and cooling design temperatures for local conditions using ASHRAE design data, which is also located in Joint Appendix 2.
- Prepare an input file that describes the other thermal aspects of the proposed design according to the rules described in the program's compliance supplement.
- Input values and assumptions must correctly correspond to the proposed design and conform to the required mandatory measures.
- Run the computer program to automatically generate the energy budget of the standard design and calculate the energy use of the proposed design.

#### 11.3.1.1 Computer Input Files

When creating any computer input file, use the space provided for the project title information to concisely and uniquely describe the building being modeled. User-designated names should be clear and internally consistent with other buildings being analyzed in the same project. Title names and explanatory comments should assist individuals involved in both the compliance and enforcement process.

### 11.3.2 Basic Data Entry

#### 11.3.2.1 The following elements

The following elements are used by approved computer programs. These elements must be consistent with plans and specifications submitted in the building permit application:

**Opaque Exterior Walls:** Each opaque exterior wall construction assembly, as well as wall area, orientation and tilt. Heat capacities, or characteristics necessary to determine the heat capacity (conductivity, mass, volume) of opaque exterior walls, must be included.

**Doors:** All doors must be included.

**Opaque Roofs/Ceilings:** Each opaque exterior roof/ceiling construction assembly, as well as roof/ceiling area, solar reflectance and thermal emittance, orientation and tilt. Heat capacity, or characteristics necessary to determine the heat capacity (conductivity, mass, volume) of opaque exterior roof/ceilings, must be included.

**Raised Floors and Slab Floors:** Each floor construction assembly, as well as floor area.

**Fenestrations in Walls and Shading:** Each vertical glass area, orientation, tilt, U-factor and solar heat gain coefficient.

**Horizontal (Skylight) Glass and Shading:** Each horizontal or skylight glass area, orientation, tilt, U-factor and solar heat gain coefficient.

**Ventilation (Outside) Air:** Ventilation (or outside air) values in cfm/ft<sup>2</sup>.

**Fan Power:** Fan power must be included. Fan power should be based on either brake horsepower (HP) at ARI conditions, nominal HP at ARI conditions, or brake horsepower at actual operating conditions (modeled horsepower must be substantiated by information contained in the construction documents).

**Cooling and Heating Efficiency:** The actual efficiency of the equipment included in the proposed design.

**HVAC System Type:** The basic type of the cooling and heating system (multiple zones or single zone) and the heating system fuel type (fossil fuel or electric). Note that some projects may have different system types serving separate zones.

**No Heating or Cooling Installed:** If total heating or cooling capacity is not specified, the TDV energy use will be based on a standard design heating or cooling system (§140.1(b)).

**Sensible and Total Cooling System Capacity:** Sensible and total output capacity of the cooling system at ARI conditions.

**Heating System Capacity:** The output capacity of the heating system.

**Indoor Lighting:** Lighting loads and modeling non-required controls for credit

**Other System Values:** All other space conditioning system components, process loads, or any other mechanical system that impacts the building energy performance must be included in the input file

#### **11.3.2.2 Compliance Software**

Refer to the compliance software user's manual for more detailed information on how each of the above values is used by the program.

### **11.3.3 Calculating TDV Energy**

The compliance software calculates TDV energy for three main components: the space conditioning energy use, the indoor lighting energy use, and the service water heating energy use. It does not allow energy credits or penalties for plug loads (even though a default value for the internal gains from plug loads are modeled in the hourly computer simulation), vertical transportation (elevators), garage ventilation, outdoor lighting or other miscellaneous energy uses.

The proposed building energy budget is defined by §140.1(b) and includes the envelope, space conditioning and ventilation, indoor lighting and water heating systems assigned to the building. The key component of calculating the TDV energy use of the proposed building is that if a feature of the building is not included in the building permit application, the energy use of that feature is equal to that of the standard energy budget defined in



§140.1(a). That means that if a permit is submitted for a shell building (envelope only), and the performance approach is used to demonstrate compliance, trade-offs cannot be made between the envelope and the mechanical or lighting system.

The standard design budget is defined by replacing all of the energy features of the proposed building with a combination of the envelope features listed in the prescriptive package requirements in Tables 140.3 B or C and the lighting and mechanical values associated with the building occupancy and design defined in the Alternative Calculation Reference Manual.

#### **11.3.3.1 Space Conditioning Energy Budget**

The space conditioning energy budget is automatically determined from the program user's inputs and the corresponding elements of the proposed design. This budget is automatically re-calculated with each compliance run.

#### **11.3.3.2 Lighting Energy Budget**

The indoor lighting budget consists of the lighting power used by a building based on one of the following criteria:

- When no lighting plans or specifications are submitted for permit, and the occupancy of the building is not known, the standard lighting power density is 0.6W/ft<sup>2</sup>.
- When no lighting plans or specifications are submitted for permit and the occupancy of the building is known, the standard lighting power density is equal to the corresponding Watt per ft<sup>2</sup> value derived in the Complete Building Method of §140.6(c)1.
- When lighting plans and specifications are submitted for permit, the standard lighting power density is equal to the corresponding total allowed lighting power (in watts) that was used in calculating the proposed lighting level which can be based on either the Complete Building Method, the Area Category Method, or the Tailored Method [§140.6(c)1, 2 or 3]. For "merchandise sales" areas, where the proposed lighting power is lower than the Prescriptive allowed lighting power, the ACM program calculates the proposed lighting power at the Prescriptive allowed lighting power. A complete set of lighting plans and prescriptive forms are required for use of the Tailored Lighting Method in the performance approach.

For all occupancies except hotel guest rooms and high-rise residential living quarters, the proposed lighting power density is expressed in W/ft<sup>2</sup>. For residential occupancies (hotel guest rooms or high-rise residential buildings), the approved computer program will set the proposed lighting power density and the standard design LPD at the same value as specified in the Nonresidential ACM Reference Manual.

#### **11.3.3.3 Service Water Heating Energy Budget**

The service water heating budget consists of the service water heating energy used by a building, assuming the service water heating system meets both the mandatory and prescriptive requirements for water heating.

The service water heating TDV energy use is calculated using one of two methods. For nonresidential occupancies a method described in the Nonresidential ACM Reference Manual uses the proposed design with minimal efficiency equipment as the standard design. For hotel, motels and high-rise residential buildings the method is described in the Residential ACM Reference Manual. This method sets the standard

design based on gas fired equipment using either individual water heaters in each unit or a central system to define the standard design. The installed system must be consistent with plans and specifications submitted in the building permit application. When complete building method performance approach is used for nonresidential occupancies the service water heating systems must be included in the performance analysis. If mechanical compliance is met using prescriptive approach water heating can also use the prescriptive approach.

For high-rise residential buildings, hotel and motels the water heating TDV energy budget is calculated using the methods and assumptions documented in the Residential ACM Reference Manual. The approval procedure is the same as that used for nonresidential occupancies: – service water heating may use the prescriptive approach only if mechanical is also approved using prescriptive approach.

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## **11.4 Application Scenarios**

The performance approach may be used for whole building permit applications; or for permit applications that involve combination of either building envelope and indoor lighting or the mechanical system or for lighting and mechanical together. The performance method may be used to demonstrate compliance with the envelope alone or the mechanical system alone, but cannot be used to show lighting compliance alone. When less than a whole building is being considered, this is called a permit phase, e.g. the building envelope would be constructed in one permit phase, the mechanical system in another, etc.

### **11.4.1 Whole Building Compliance**

Whole buildings are projects involving buildings where the applicant is applying for a permits and is submitting plans and specifications for all the major components of the building (envelope, mechanical, indoor lighting and service water heating). This could be a first-time tenant improvement that involves envelope, mechanical and lighting compliance; or a complete building, where plans and specifications for the entire building are being submitted for permit.

When a whole building is modeled using the performance approach, trade-offs can be made between the envelope, space conditioning, service water heating, and indoor lighting systems that are included in the permit application.

### **11.4.2 Compliance by Permit Stage**

Compliance with only one or more building permit stages can be done using the performance approach except that indoor electrical lighting cannot be done alone. A permit stage is a portion of a whole building permit: either envelope, mechanical, or electrical. This means that trade-offs in energy use are limited to include only those features, or single feature in the case of envelop or mechanical, included in the building permit application.

There are two basic scenarios that occur when performing compliance by permit stage: modeling future construction features that are not included in the permit application, and modeling existing construction that has complied with the Standards.

#### **11.4.2.1 Modeling Future Construction by Permit Stage**

When a feature of a building is not included in the permit application, it is required to default to a feature automatically determined in the computer program. The defaults vary for envelope, mechanical, and indoor lighting. The Nonresidential ACM Reference Manual and the program vendor's compliance supplement contain additional information on the default values.

The default envelope features do not apply when modeling future construction. Usually, this is the first permit requested and at a minimum this feature must be modeled. The proposed building's envelope features are input and an energy budget is automatically generated based on the proposed building's envelope, and/or space conditioning and indoor lighting system.

The default space conditioning system features are fixed if no space conditioning system exists in the building. A standard package gas/electric unit is assumed for each thermal zone in the proposed design. The package system is sized based on the envelope design and whether it meets the prescriptive requirements. If a space conditioning system is included in the permit application, the default space conditioning system is based on the standard design as determined in the Nonresidential ACM Reference Manual.

The default lighting system features depend on whether or not the occupancy of the building is known. If the building occupancy is known, the allowed lighting power density is determined using the Complete Building Approach for each zone that the occupancy is known. If the building occupancy is not known, 0.6 W/ft<sup>2</sup> is assumed for both the proposed energy use and the energy budget.

The default service water heating system features are fixed based on building occupancy. Default service water heating systems are specified for each occupancy type. For nonresidential occupancies other than high rise residential, hotel and motels the default can be gas or electric fired.

#### **11.4.2.2 Modeling Existing Construction by Permit Stage**

When existing indoor lighting or an existing mechanical system is not included in the permit application, the compliance software may use default values for certain inputs. The Nonresidential ACM Reference Manual contains additional information on the default values.

The envelope features are based on the program user's inputs to the compliance software. The user inputs the proposed building's conditioned floor area, glazing, wall, floor/soffit, roof/ceiling, and display perimeter features. The compliance software then applies the proposed building's features to the standard design in order to calculate the energy budget. If an application for an envelope permit is not being sought, the compliance software will automatically default the features of the standard design to be the same as the features of the proposed design. Only the EXISTING-ENV will be printed to document the existing building.

Default space conditioning system features are fixed based on the building's existing space conditioning system. The program user inputs the existing space conditioning system, including actual sizes and types of equipment. The compliance software then applies the proposed building's space conditioning features to create a standard design mechanical system used to calculate the energy budget. This means that if an application is not being sought for a mechanical permit, the computer program will

automatically default the features of the standard design to be the same as the features of the proposed design. No mechanical forms will be printed.

Default service water heating system features are fixed based on building occupancy. Default service water heating systems are specified for each occupancy type. Water heating information will only be listed as "Existing".

Default lighting system features are based on the known occupancy of the building. The allowed lighting power density (LPD) is determined based on the Complete Building LPD for the proposed design, or an Existing Modeled LPD from field data. The compliance software then applies the proposed building's indoor lighting LPD the standard design in order to calculate the energy budget. This means that if an application for a lighting permit is not being sought, the compliance software will automatically default the lighting features of the standard design to be the same as the lighting features of the proposed design. No LTG form will be printed. All modeled indoor lighting will be reported on the PERF-1 Performance Certificate of Compliance.

### **11.4.3 Additions Performance Compliance**

An addition consists of both new conditioned floor area and added volume, and it is treated similar to a new building in the performance approach. All systems serving the addition will require compliance to be demonstrated; and either the prescriptive or performance approach can be used for each stage of the construction of the addition.

*Note:* When existing space conditioning or water heating is extended from the existing building to serve the addition, those systems do not need to comply with new construction energy efficiency requirements; however, all applicable mandatory measures must be met for new components and controls. .

#### **11.4.3.1 Addition Only**

Additions that show compliance with the performance approach independent of the existing building must meet the requirements for new buildings. §140.1 states that the envelope and indoor lighting in the conditioned space of the addition, and any newly installed space conditioning or service water heating system serving the addition, must meet mandatory measures and the applicable energy budget:

- If the permit is done in stages, the rules for each permit stage apply to the addition performance run.
- If the whole addition (envelope, lighting and mechanical) is included in the permit application, the rules for whole buildings apply.

#### **11.4.3.2 Existing Plus Addition**

Additions may also show compliance by either:

- Demonstrating that efficiency improvements to the envelope component of the existing building, as well as certain indoor lighting and mechanical improvements, offset substandard addition performance (see §141(a)2Bii); or,
- That the existing building combined with the addition together meet the requirements of §141.0(b) as all new construction.

§141.0(a)2 states that the envelope and indoor lighting in the conditioned space of the addition, and any newly installed space conditioning or service water heating system

serving the addition, must meet the mandatory measures as if it were an addition only. The energy use of the combination of the altered existing building plus the proposed addition shall be equal to or less than the energy use of the existing building with all alterations meeting the requirements of §141.0(b)2 plus the standard energy budget of an addition that complies with §140.1.

For a full description of when and how altered components in the existing building are counted as a credit or penalty in the performance calculation, as well as basic energy modeling rules for alterations, see section 11.4.4.2, Alterations in Existing Buildings Without an Addition.

This approach allows the applicant to improve the energy efficiency of the existing building so that the entire building meets the energy budget that would apply, if the existing building were unchanged, and the addition complied on its own. Changes to features in the existing building are considered alterations.

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**Example 11-2****Question**

3,000 ft<sup>2</sup> of conditioned space is being added to an existing office building. 25 percent of the lighting fixtures in the existing office space are being replaced with more efficient fixtures. Can credit be taken for the improved lights in the existing building to comply through the existing-plus-addition performance approach?

**Answer**

Credit can only be taken for lighting efficiency improvements resulting in a lower lighting power density than is required to meet §140.6. Otherwise, credit may be taken for improvement(s) to the envelope components only. Lighting in the existing building must meet all prescriptive requirements in this case (more than 10 percent of the lighting fixtures are replaced or the connected load is increased).

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### 11.4.4 Alterations Performance Compliance

Using the performance approach for an alteration is similar to demonstrating compliance with an addition.

#### 11.4.4.1 Alterations of the Permitted Space

Altered spaces can show compliance with the performance approach independent of the remainder of the existing building, but must still meet the requirements for the altered components of the building as specified in §141.0(b)2B and C. §141(b) states that envelope and lighting alterations, as well as any new or replacement space conditioning or service water heating system serving the alteration, must meet the mandatory measures. The permitted space alone may comply with the energy budget determined using Energy Commission-approved compliance software.

If the permit is done in stages, the rules for each permit stage apply to the alteration performance run.

#### 11.4.4.2 Alterations in Existing Buildings without an Addition

Alterations may also show compliance by demonstrating that the energy use of the proposed design -- including all energy efficiency improvements to the existing building -- is equal to or less than the standard design energy budget which is based on the alterations meeting the requirements of §141.0(b)2 and Table 141.0-D. Note that

§141.0(a)1 also requires that envelope, lighting, space conditioning and service water heating system alterations meet the applicable mandatory measures.

This approach allows the applicant to improve the energy efficiency of the existing building so that it meets the energy budget that would apply to the entire building if the existing building other than the portion being altered was unchanged. Changes to features in the existing building are considered alterations.

An energy penalty is assigned to any altered component that does not meet or exceed the requirements of §141.0(b)2B. A credit is assigned to an alteration (improvement) that exceeds the requirements in §141(b)2B as summarized in Table 141.0-D and further detailed in the Nonresidential ACM Reference Manual. The compliance software sets the standard design for the type altered component as listed in Table 141.0-D.

Fenestration is the only type of altered component where the difference between the existing glazing type and the altered glazing type can be used as a credit in the Existing-Plus-Addition-Plus-Alteration performance calculation. In order to obtain this credit, a third party inspector must:

- (a) Site verify all existing fenestration type(s) to be altered as shown on the PERF-1 form; and
- (b) Sign a Verification of Existing Fenestration (Form VEF) to submit to the local enforcement agency as part of the Title 24 compliance report.

For further details of this process, see section 11.4.4.2, Alterations in Existing Buildings.

This compliance approach includes the entire building which means the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all conditioned and unconditioned space within the structure. However, the inclusion of the unconditioned spaces do not affect the overall performance budget of the building since indoor lighting allowances cannot be traded off between the conditioned and unconditioned spaces, and the installed indoor lighting in the unconditioned portion of the building does not affect the heating and cooling budget of the building.

When using this compliance approach it is important to take into account all changes in the building's features that are:

- **EXISTING** (that remain unchanged);
- **ALTERED** (improved or replacement); and
- **NEW** (all new).

Note that surfaces which are being completely removed from the existing building – roofs/ceilings, exterior walls and floors, and all glazing removed within those surfaces – are not modeled (as was the case under the 2008 and earlier Standards).

Except for replacement fenestration with third party verification of the existing glazing type, the allowed for trade-off by improving the existing building is limited to the amount a particular improvement exceeds the applicable prescriptive requirements of §141.0(b)2.

To show compliance with this approach you need to follow the instructions in the compliance software user's manual. Documentation of the existing building's glazing areas is required to be submitted with the permit application if this method is used for replacement fenestration credit.



## Example 11-3

**Question**

Alterations to an existing office building in Climate Zone 12 includes replacing all single clear metal frame operable windows with new NFRC-rated windows (U-factor =0.45, SHGC=0.31.) What standard design values will the compliance software use for the replacement fenestration area?

**Answer**

If the software user does not select Third Party Verification of the existing fenestration type, the standard design will use the values in Table 141.0-A (U=0.47 and SHGC=0.31) regardless of whether the replacement windows exceed those Table 141.0-A values.

If Third Party Verification of existing fenestration is selected, the standard design will use the applicable values in Table 110.6A and 110.6-B for the existing windows (U=1.28 and SHGC=0.83) because the replacement windows meet or exceed the Table 141.0-A values.

In this case, the compliance software will show a larger compliance credit for improving the existing windows.

**11.4.4.3 Existing-Plus-Addition-Plus-Alteration**

For additions, the most flexible compliance method is to consider the entire existing building along with the addition (Existing + Addition + Alteration)<sup>1</sup>. The combination of additions and alterations to the existing building may be shown to comply by demonstrating that the proposed design energy use is equal or less than the standard design energy budget based on the alterations meeting the requirements of §141.0(b)2 summarized in Table 141.0-D and additions meeting the requirements of §141.0(a)2.

For a full description of when and how altered components in the existing building are counted as a credit or penalty in the performance calculation, see section 11.4.4.2, Alterations in Existing Buildings without an Addition.

When using this compliance method, all building components and systems input must be identified (tagged) as one of the following

- **EXISTING.** An existing component or system in the building that remains unchanged.
- **ALTERED.** An existing component or system that is being altered, changed, or replaced within the permitted scope of work.
- **NEW.** A newly installed component or system that was not a part of and/or did not previously serve the existing building.

Note that surfaces which are being completely removed from the existing building – roofs/ceilings, exterior walls and floors, and all glazing removed within those surfaces – are not modeled (as was the case under the 2008 and earlier Standards.)

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<sup>1</sup>This method may also be used whenever an alteration is made to existing buildings, whether or not there is an addition to the building at the same time.

Except for replacement fenestration with third party verification of the existing glazing type, the allowed for trade-off by improving the existing building is limited to the amount a particular improvement exceeds the applicable prescriptive requirements of §141.0(b)2.

To show compliance with this approach you need to follow the instructions in the compliance software user's manual. Documentation of the existing building's glazing areas is required to be submitted with the permit application if this method is used for replacement fenestration credit.

Using this compliance method, credit may be taken for energy efficiency features added to the existing building. When the prescriptive approach is used, compliance can be demonstrated if the altered component meets or exceeds the requirements of §141.0(b)1 for that component. When the performance approach is used, the altered component must meet or exceed the requirements in §141.0(b)2, or another alteration(s) must be made to the existing building, which exceeds the requirements of §141.0(b)2 that saves the additional energy necessary to at least make up for the alteration(s). Alternatively, when there is an addition, the addition can be designed to exceed prescriptive requirements to offset proposed existing building alterations that do not meet prescriptive requirements.

Alterations may include previous fenestration improvements that were made to the building after original permit (when the existing building was first constructed). The upgraded efficiency values of the current fenestration must be documented as the proposed design; and the standard design is based on the current Standards. The permit applicant must provide evidence that the previous glazing improvements were made subsequent to the original construction of the building, and documentation to confirm the glazing type of previously existing fenestration. Such evidence may involve a receipt, a signed statement from previous owners, or in case where previous owners are not available, a signed statement of the current owner or other record. Note that previous fenestration improvements that have been used to achieve compliance for previous additions and alterations cannot be considered for compliance for subsequent additions and alterations.

#### **11.4.5 Alternate Performance Compliance Approach**

Any addition, alteration or repair may demonstrate compliance by meeting the requirements applicable to new buildings for the entire building. Using this method, the entire building could be shown to comply in permit stages or as a whole building. The rules for new buildings permit stage compliance, and whole building compliance would apply.

Documentation of the existing building's features is required to be submitted with the permit application if this method is used.

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### **11.5 Enforcement and Compliance**

At the time a building permit application is submitted to the enforcement agency, the applicant also submits plans and energy compliance documentation. This section describes the forms and procedures for documenting compliance with the performance requirements. The Nonresidential ACM Reference Manual has specific and detailed output/reporting requirements for all approved compliance software.



Compliance software output is required to specify the run initiation time, a unique run code, and the total number of pages of forms printed for each proposed building run on each page whenever a building complies with the Standards and compliance output has been selected. The plan checker is strongly encouraged to verify these output features for a performance compliance submittal to ensure that the submittal is a consistent set of compliance documentation. The Nonresidential ACM Technical Manual forbids compliance software from printing standard compliance forms for a proposed building design that does not comply. The plan checker should pay special attention to the PERF-1 form and the Exceptional Conditions List on Part 2 of that form. Every item on the Exceptional Conditions List deserves special attention and may require additional documentation, such as manufacturer's cut sheets or special features on the plans and in the building specifications.

The compliance software requirements will automatically produce and reiterate the proper set of forms that correspond to the particular proposed building submitted for a permit. However, the plan checker should verify the type of compliance and the required forms from the lists below. Whenever an existing building or existing building components are involved in the compliance calculation, the plan checker should look for the term EXISTING that identifies EXISTING building components that remain unchanged. Similarly if the compliance form indicates a component is ALTERED these changes should be verified. In the types of permit applications where some building components are unknown, the unknown components cannot be entered by the user and cannot be reported on output forms.

The following discussion is addressed primarily to the enforcement agency plan checkers who are examining documents submitted to demonstrate compliance with the Standards, and to the designer preparing construction documents and compliance documentation.

Most compliance forms associated with the computer method approach are generated automatically. These reports are similar in information content and layout to their prescriptive method counterparts.

The following summary identifies the forms that are required for performance compliance. All submittals must contain the following information:

Unless minimal efficiency and default capacities are used in the performance analysis, either equipment cut sheets showing rated capacities, fan bhp, and airflow at ARI conditions, or the installation certificate must be provided.

Other documentation supporting each non-standard or non-default value used in the performance approach and indicated in the Exceptional Conditions list on the PERF-1 form must also be included.

Other reports that may be generated by a program are:

Construction Assemblies Worksheet for adjusting and combining assemblies from Reference Joint Appendix JA4

Formatted Copy of Input.

The following computer generated forms are required by the ACM Manual for a permit application:

**Whole Building Compliance** (the number of parts is the minimum number of pages):

PERF-1: Performance Certificate of Compliance

DESC-1C: Design Review Checklist – Design Review Kickoff

DESC-2C: Design Review Checklist – All Buildings

DESC-3C: Design Review Checklist – Simple HVAC Systems

DESC-4C: Design Review Checklist – Complex Mechanical Systems

DESC-5C: Design Review Signature Page

ENV-1C: Envelope Certificate of Compliance (2 parts)

MECH-1C: Mechanical Certificate of Compliance (1 part)

MECH-2C: Air System, Water Side System, Service Hot Water & Pool Requirements (3 parts)

MECH-3C: Mechanical Ventilation (1 part)

LTG-1C: Lighting Certificate of Compliance (3 parts)

The LTG-4C (Lighting Controls Credit Worksheet) and LTG-6C (Tailored Method Summary and Worksheet) forms may be, and typically will be, submitted by hand. When these pages are hand submitted or submitted independently, they will not be included in the page count automatically generated by the computer for a compliance submittal.

*Note:* The use of the tailored lighting approach requires independent prescriptive compliance for the lighting system.

### **11.5.1 Compliance By Permit Stage**

#### **11.5.1.1 Envelope Only**

PERF-1: Performance Certificate of Compliance

ENV-1C: Envelope Certificate of Compliance (2 parts)

DESC-1C: Design Review Kickoff

DESC-2C to DESC-4C: Design Review Checklists

DESC-5C: Design Review Signature Page

#### **11.5.1.2 Envelope and Mechanical**

PERF-1: Performance Certificate of Compliance

ENV-1C: Envelope Certificate of Compliance (2 parts)

MECH-1C: Mechanical Certificate of Compliance (1 part)

MECH-2C: Air System, Water Side System, Service Hot Water & Pool Requirements (3 parts)

MECH-3C: Mechanical Ventilation (1 part)

DESC-1C: Design Review Kickoff

DESC-2C to DESC-4C: Design Review Checklists

DESC-5C: Design Review Signature Page

#### **11.5.1.3 Mechanical Only**

PERF-1: Performance Certificate of Compliance

MECH-1C: Mechanical Certificate of Compliance (1 part)

MECH-2C: Air System, Water Side System, Service Hot Water & Pool Requirements (3 parts)

MECH-3C: Mechanical Ventilation (1 part)

Possibly existing ENV and/or existing LTG forms: (for partial compliance alteration)

DESC-1C: Design Review Kickoff

DESC-2C to DESC-4C: Design Review Checklists

DESC-5C: Design Review Signature Page

#### **11.5.1.4 Mechanical and Lighting**

PERF-1: Performance Certificate of Compliance

MECH-1C: Mechanical Certificate of Compliance (1 part)

MECH-2C: Air System, Water Side System, Service Hot Water & Pool Requirements (3 parts)

MECH-3C: Mechanical Ventilation (1 part)

LTG-1C: Lighting Certificate of Compliance (3 parts)

LTG-4C: Lighting Controls Credit Worksheet (if control credits used)

LTG-6C (3 parts): Tailored Method Summary and Worksheet (if tailored lighting used)

Existing ENV forms: (for partial compliance alteration)

DESC-1C: Design Review Kickoff

DESC-2C to DESC-4C: Design Review Checklists

DESC-5C: Design Review Signature Page

### **11.5.2 Compliance Forms**

#### **11.5.2.1 DESC-1-C: Design Review Kickoff Certificate of Compliance**

The schematic design review has one part that is completed during the schematic design phase of the project. This form documents that the owner or owner's representative, design team and design reviewer have met to discuss the project scope, schedule and how the design reviewer will coordinate with the project team.

#### **11.5.2.2 DESC-2-C: Construction Document Design Review – All Buildings Certificate of Compliance**

This form contains a listing of the items that should be checked by the design reviewer during the construction document review. Code items as well as best practice suggestions for simple mechanical systems have been incorporated. For projects following the performance approach, compliance may be achieved through measures not identified on the checklists. These alternative measures should be documented on the design review checklist forms. The completed form is returned to the owner and design team for review and sign-off.

**11.5.2.3 DESC-3-C: Construction Document Design Review – HVAC Simple Certificate of Compliance**

This form contains a listing of the items that should be checked by the design reviewer during the construction document review. Code items as well as best practice suggestions for envelope, mechanical systems and lighting systems have been incorporated into the form. For projects following the performance approach, compliance may be achieved through measures not identified on the checklists. These alternative measures should be documented on the design review checklist forms. The completed form is returned to the owner and design team for review and sign-off.

**11.5.2.4 DESC-4-C: Construction Document Design Review – HVAC Complex Certificate of Compliance**

This form contains a listing of the items that should be checked by the design reviewer during the construction document review. Code items as well as best practice suggestions for complex mechanical systems have been incorporated. For projects following the performance approach, compliance may be achieved through measures not identified on the checklists. These alternative measures should be documented on the design review checklist forms. The completed form is returned to the owner and design team for review and sign-off.

**11.5.2.5 DESC-5-C: Design Review Signatures Certificate of Compliance**

This form contains the signatures for the owner, design engineer and design reviewer to certify that design review requirements have been completed.

**11.5.2.6 ENV-1-C: Envelope Certificate of Compliance**

The performance ENV-1C Envelope Compliance Summary form has one part. It summarizes the opaque surfaces including surface type, construction type, area, azimuth, and U-factor. Next it summarizes the fenestration surfaces including fenestration type, area, azimuth, U-factor, frame type and solar heat gain coefficient. Lastly, it includes exterior shading and overhangs including shade type, solar heat gain coefficient, overhang height and overhang width.

For a description of the information contained on the ENV-1C Envelope Compliance Summary, see ENV-1C, Part 2 of 2.

**11.5.2.7 ENV-2-C: Envelope Component Method**

The envelope component method can be used when fenestration and skylight areas do not exceed prescriptive limits, when roofing products meets mandatory performance criteria of §110.8, and when all envelope components meet prescriptive criteria in §140.3 .

**11.5.2.8 ENV-3-C: Overall Envelope Method**

This form is identical to the form required in the prescriptive approach. This form is used when the overall envelope approach is used to show envelope compliance. This allows for trade-offs between different envelope components.

**11.5.2.9 MECH-1-C: Mechanical Certificate of Compliance**

The MECH-1C Mechanical Compliance Summary form is in one part.

For a description of the information contained on the MECH-1C Mechanical Certificate of Compliance, consult the computer program's compliance supplement.

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**11.5.2.10 MECH-2-C: Air System, Water Side System, Service Hot Water & Pool Requirements**

The MECH-2C identifies the mechanical equipment modeled in the alternative computer program to show compliance.

For more information on the MECH-2C, refer to the computer program's compliance supplement.

**11.5.2.11 MECH-3-C: Mechanical Ventilation**

The MECH-3C Mechanical Ventilation contains the information on the design outdoor ventilation rate for each space. Refer to the computer program's compliance supplement for more information.

**11.5.2.12 LTG-1-C: Lighting Certificate of Compliance**

The LTG-1C Lighting Certificate of Compliance form is a single part form. It is used to describe the lighting fixtures and control devices designed to be installed in the building.

For a description of the information contained on the LTG-1C Lighting Certificate of Compliance, see LTG-1C, Part 2.

If control credits were input by the program user, a copy of the LTG-4C must accompany the permit application. If the tailored method was used, a copy of the LTG-6C must accompany the permit application along with a complete set of lighting plans and specifications.

**11.5.3 Performance Inspection**

Performance approach inspection is identical to other inspections required by the Standards. For information on inspection of envelope, mechanical and lighting systems, refer to Chapter 2, Compliance and Enforcement.

When tailored lighting is used to justify an increase in the allowed lighting watts, a lower lighting load in the proposed design cannot be modeled for credit. The standard design building uses the lesser of allowed Watts per ft<sup>2</sup> or actual lighting power to be installed in the building. The proposed design building uses the actual lighting power to be installed as detailed on the lighting plans. This value must be equal to or greater than the allowed Watts per ft<sup>2</sup>.